HIGH PERFORMANCE CONCRETE QUESTIONNAIRE

Version: 7-15-03

State: CALIFORNIA

1. Which of the following changes have been made to your concrete specifications in the last 10 years?

NOTE: SOME OF THESE "CHANGES" HAVE BEEN IN THE SPECS. FOR LONGER THAN 10 YEARS

Check those that apply:

	Changes Made in Last 10 Years	Included in Current Specifications
Use HPC-low permeability concrete *	✓	✓
Use HPC-high strength concrete * (8ksi max)	✓	✓
Allow admixtures	✓	✓
Concrete strengths	✓	✓
Bridge deck curing	✓	✓
Deck finishing requirements	✓	✓
Limit cement/alkali content	✓	✓
Testing and acceptance requirements	✓	✓
Heat of Hydration required for cement	✓	✓
Chloride testing of hardened concrete	✓	✓
Lightweight concrete	✓	✓
Self-consolidating concrete (SCC) in use	—	✓ NEW
Flowing concrete in use	—	✓ NEW
Epoxy coated reinforcing steel used	✓	✓
Stainless Steel reinforcing steel used	NOT USED	NOT USED
Stainless clad reinforcing steel used	NOT USED	NOT USED
Specify air void parameters (spacing factor and/or specific surface)	NO	NO

* NOT SPECIFICALLY CALLED OUT AS SUCH.

2. Current Concrete Specifications:

Class of Concrete	Air Content % *	Max. W/C Ratio	Slump (in.)	Cement Type	Min. Cement Content (lb/cy)	Max. Cement Content (lb/cy)	Maximum Aggregate Size (in.)
Prestressed	4-6	0.5	NO	TYPE I PS or TYPE IL or TYPE V	400	550①	1.5
Decks	"	0.5	"		400	475	"
Parapets	"	0.5	"		400	475	"
Substr./General	"	0.5	"		400	475	"
Paving	"	0.54	"				"
Latex Hydraulic Cement Concrete	← NOT USED →						
Silica Fume Concrete	4-6		"				1.5"

* 6% max in freeze thaw; 4% max if air is optional.
① Precast.

Highest compressive strength used for prestressed concrete girders: 8000 psi
Compressive concrete strength used for decks: 6000 psi

3. All states have experienced some of the below concrete distresses. To what extent has your State experienced these (Rank from 1 to 5 with 1=rare and 5=often):

Type of Distress	1	2	3	4	5
Corrosion of Reinforcing Steel		✓			
Sulfate Attack		✓			
Alkali-silica Reactivity		✓			
Freezing and Thawing	✓				
Cracking (girders, substructure, pvmt)				✓	
Deck Cracking (Early age < 5 years)			✓		
Overload					
Poor Construction Quality	✓				

4. Construction Requirements:
Workability Requirements:

ADMIXTURES AND SLAG USAGE					
ADMIXTURE/SLAG	Non-Aggressive Environment		Aggressive Environment		ELEMENTS WHERE USED
	YES	NO	YES	NO	All, D, G, P, F, CP, DS*
Air-Entraining			*		ALL
Retarding					
Accelerating					
Water Reducing (Normal)					
Water Reducing (High Range)	THE USE OF ADMIXTURES IS AT				
Water Reducer + Retarder	CONTRACTORS OPTION				
Water Reducer + Accelerator					
Viscosity Modifying Admixture					
Silica Fume			✓		
Fly Ash, Class F	MANDATORY IN ALL ELEMENTS EXCEPT PRECAST				
Fly Ash, Class C		✓		✓	
Fly Ash, Class N		✓		✓	
Metakaolin		✓	✓		
Rice Hull Ash		✓		✓	
Other Ash Materials		✓		✓	

* REQUIRED FOR AGGRESSIVE ENV.

Bark Ash		X		X	
Bottom Ash		X		X	
Pet Coke Ash		X		X	
Slag			X	→	COLUMNS ON NEW BAY BR.
Latex		X		X	
Corrosion Inhibitors		X		X	

*Key: Deck(D); Girder(G); Pier(P); Footing(F); Concrete Pile(CP); Drilled Shaft(DS)

ADMIXTURE TYPE & SLAG	RANGE % (Wt. Of Cement Replaced)
Fly Ash	35% max. (25% mandatory)
Slag	50% (BAY BRIDGE NEW)
Silica Fume	10% max
Metakaolin	10% max
Rice Hull Ash	NO
Other Ash Materials	NO

	Yes	No
Is water allowed to be added at the job site?	✓	
Are air-entraining admixtures allowed to be added at the job site?		✓
Are accelerators added at the job site?	✓	
Are there any special finishing requirements?		✓

Explain: N/O

Are there any time constraints between finishing and applying curing? ✓

Explain: (Minimum and Maximum Times) Curing should be applied immediately

CURING REQUIREMENTS						
Structural Element	Exist. Spec. Y/N	Curing Comp. Y/N	Fog Mist Y/N	Wet Burlap Duration	ERL LB/SF/HR	Cure Time (Days)
Deck	Y	Y	Y	Y	NO	7 DAYS
SF Overlay						
Latex Conc. Overlay						
Dense Conc. Overlay						
Paving	Y	Y	N	N	N	7 DAYS
Shotcrete	Y	Y	N	Y	N	3 DAYS
Shotcrete With SF						
Massive Element	NO	SPEC AT THIS TIME				

Key : ERL= Evaporation Rate Limit (LBS/SF/HR)

Any construction requirements for reducing evaporation?

Yes _____ No X

How and how often is evaporation rate measured?

5. Has fiber-reinforced concrete been specified for bridge decks or overlays and paving (either steel or plastic fibers)(Indicate R = Regular and E = Experimental.)

Bridge decks: Yes _____ No X Fiber Type _____
Overlays: Yes _____ No X Fiber Type _____
Paving: Yes _____ No X Fiber Type _____

6. Identify concrete cover requirements:

MINIMUM CONCRETE COVER REQUIREMENTS		
STRUCTURAL ELEMENT	COVER (in.)	
	Non-Aggressive Environment	Aggressive Environment *
Decks – Top	2	2.5
Decks – Bottom	1.5	1.5 – 2.5
Reinforced Concrete Beams	1.5	2.0 – 3.0
Prestressed Concrete Beams - CIP	1.5	2.0 – 3.0
Prestressed Concrete Beams - Precast	1.0	VARIES
Substructure – Piers	2.0	2.0 – 4.0
Substructure – Abutments	2.0	2.0 – 4.0
Substructure - Footings	3.0	2.0 – 5.0

* Depends on amount/type of admixtures.

REQUIRED REINFORCING STEEL			
STRUCTURAL ELEMENT	TYPE REINFORCING STEEL BS, ECS, GS, SS, SCD, MMFX		
	Non-Aggressive Environment	Aggressive Environment	Experimental Use Only
Decks – Top	BS	ECS	
Decks – Bottom			
Reinforced Concrete Beams			
Prestressed Concrete Beams, CIP			
Prestressed Concrete Beams, Precast			
Substructure – Piers			
Substructure – Abutments			
Substructure - Footings	BS	ECS	

Key: BS = Black Reinforcing Steel; ECS = Epoxy Coated Reinforcing Steel; GS = Galvanized Reinforcing Steel; SS = Stainless Reinforcing Steel; SCD = Stainless Clad Reinforcing Steel; MMFX = MMFX Microcomposite Steel Rebar

7. Is there a limit on the percent of alkali allowed in the cement?

Yes ✓ (1.5%) No _____

8. Are aggregates tested for reactivity?

Yes ✓ No _____

How many sources of aggregates? 122 (As of Sept 2003)

9. Indicate specification permeability requirement limits for: NONE

Structural Element	Coulombs	
	Non-Aggressive Environment	Aggressive Environment
Bridge Decks		
Prestressed Concrete Members		
Substructure Elements		
Pavements		

10 (a): What QC/QA tests do you specify?

Fresh Concrete		Hardened Concrete	
	Tests		Tests
~~Slump~~ PENETRATION	Y	Compressive Strength	Y
Spread	N	Air/Void System	N
Unit Weight	Y	Chloride Permeability	N
Air Content	Y/IF MANDATORY	Maturity	N
Water Content	N	Freeze/Thaw	Y
W/CM	N	Shrinkage	N
		ASR	Y

10 (b): What are your acceptance criteria for cracks? NONE.
(The decks have to be methacrylated if there are more than 5m of cracks - larger than 0.5mm over 50 m² of deck area)

10 (c): Do you specify pre-construction mock-ups? If yes, provide details.
YES FOR PAVEMENT - TEST SLABS.

10 (d): Do you specify design properties at 28 days or 56 days or some other duration?
28 DAYS (42 DAYS FOR PAVEMENT WITH MINERAL ADMIXTURE)

10 (e): Do you allow 4x8 cylinders for compressive strength tests?
NO

10 (f): What types of end-caps do you specify/allow – Sulfur, Neoprene, Ground Ends?
SULFUR

10 (g): Do you specify match-cured cylinders?
YES

10 (h): How do you enforce/monitor wet-water curing?
THROUGH VISUAL INSPECTION - CONSTRUCTION ENGINEER

10 (i): Do you require warrantees against defects – e.g. bridge deck cracking?
If yes, provide details. NO

10 (j): What is your experience/evaluation/specification regarding the Microwave Test for w/cm?
CALTRANS INITIATED THIS PROCEDURE, BUT TO CONSTRAINTS ON POWER AVAILABILITY, IS NOT USED.

11. How often are the following types of concrete overlays used? (Rank from 1 to 5 with 1=rare and 5=often)

Type of Overlay	1	2	3	4	5	Comment on Performance E, G, or P**
Latex-modified Concrete	←	—	NO	—	→	—
Silica Fume Concrete	←	—	NO	—	→	—
Dense Concrete	←	—	NO	—	→	
Fly Ash Concrete					✓	
Slag Concrete	←	—	NO	—	→	
Epoxy (Thin Bonded)		✓				
Polymer (Thin Bonded)		✓				
Other						

**Key: Excellent(E); Good(G); Poor(P)

12. Rank the need or interest for your State to learn more about the following from 1 to 5 (1=low; 5=very high)

BENEFICIAL ATTRIBUTES	1	2	3	4	5	Overall Ranking (1-11)
Low Permeability (Dense Concrete)					✓	
High Durability					✓	
High Corrosion Resistance			✓			
Alkali-silica Reactivity Resistance			✓			
Higher Concrete Strengths	✓					
Highly Flowable Concrete					✓	
Crack Control					✓	
Skid Resistance			✓			
Rideability					✓	
Toughness of Concrete*			✓			
Minimum Maintenance			✓			
Longer Service Life					✓	
Savings (Life Cycle Costs)					✓	

*Add fibers: steel, glass, plastic, polypropolene, etc.

13. Who at State and Division levels i.e., Materials, Construction, Pavement, Research, Structures, would be involved in examining concrete specifications and procedures and learning about High Performance Concrete?

Check those that apply:

Materials ✓ TOM PYLE
Construction ✓ JOHN GILLIS / CHUCK SUSZKO
Pavement ✓ TOM PYLE
Structures ✓ MADHWESH RAGHAVENDRACHAR / TOM RUCKMAN
Research ✓ MADHWESH RAGHAVENDRACHAR / TOM HOOVER

14. Have you considered adopting/implementing the following SHRP products?

2005 A Guide to Determining the Optimal Gradation of Concrete Aggregates?

Yes ____ No ____ Unknown X Implemented ____

2014 Specifications for High Performance Concrete?

Yes ____ No ____ Unknown X Implemented ____

2017 Designing ASR-Safe concrete Mix?

Yes ____ No ____ Unknown X Implemented ____

2036 Manual for Bridge Rehabilitation and Protection

Yes ____ No ____ Unknown X Implemented ____

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Thank you for completing the questionnaire. A summary of compiled results will be made available upon completion.